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G.M.T., as indicated by an observation at Mr. Bishop's Observatory, on October 10.

The Sun's Equat. Hor. Parallax = 8″·91.

J. R. Hind.

*Twickenham*, 1871, *Oct.* 30.

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## *Ephemeris of Tuttle's Comet.*

### At Greenwich Midnight.

| 1871. | R.A. | N.P.D. | Log. Δ. |
|---|---|---|---|
| | h m s | ° ′ | |
| Nov. 1 | 9 56 52 | 66 16·9 | |
| 2 | 9 59 4 | 67 39·5 | 9·9097 |
| 3 | 10 1 15 | 69 4·0 | |
| 4 | 10 3 24 | 70 30·5 | 9·8982 |
| 5 | 10 5 53 | 71 59·4 | |
| 6 | 10 7 41 | 73 30·7 | 9·8873 |
| 7 | 10 9 49 | 5 4·1 | |
| 8 | 10 11 57 | 76 39·7 | 9·8771 |
| 9 | 10 14 5 | 78 17·4 | |
| 10 | 10 16 13 | 79 57·1 | 9·8677 |
| 11 | 10 18 21 | 81 38·8 | |
| 12 | 10 20 29 | 83 22·5 | 9·8593 |
| 13 | 10 22 37 | 85 7·9 | |
| 14 | 10 24 46 | 86 55·0 | 9·8521 |
| 15 | 10 26 55 | 88 43·7 | |
| 16 | 10 29 5 | 90 33·8 | 9·8462 |
| 17 | 10 31 15 | 92 25·0 | |
| 18 | 10 33 26 | 94 17·4 | 9·8417 |
| 19 | 10 35 37 | 96 10·7 | |
| 20 | 10 37 50 | 98 4·7 | 9·8387 |
| 21 | 10 40 4 | 99 59·2 | |
| 22 | 10 42 19 | 101 53·8 | 9·8373 |
| 23 | 10 44 35 | 103 48·5 | |
| 24 | 10 46 53 | 105 42·9 | 9·8375 |
| 25 | 10 49 12 | 107 36·9 | |
| 26 | 10 51 33 | 109 30·3 | 9·8393 |
| 27 | 10 53 56 | 111 22·8 | |
| 28 | 10 56 21 | 113 14·3 | 9·8426 |
| 29 | 10 58 48 | 115 4·7 | |
| 30 | 11 1 17 | 116 53 6 | 9·8474 |

The ephemeris is calculated from Dr. Tischler's elements, but with perihelion passage corrected to December 1, 7974, G.M.T., by observations at Paris and Hamburg.

J. R. Hind.

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## *Queries relative to Double Stars.* By Sir J. W. F. Herschel, Bart.

The Committee appointed by the Council of Royal Astronomical Society to examine and report upon the valuable collection of papers bequeathed to the Society by the late Sir J. F. W. Herschel, entitled "General History of Double Stars," have requested that the following list of queries collected by him in the course of his laborious researches should be printed in the *Monthly Notices*, as an invitation to Astronomers furnished with good libraries and good telescopes to assist in the solution of the doubts respecting the stars contained in the list.

The list is given exactly as Sir John left it, without any attempt to diminish the number of doubtful cases by reference to Struve's *Positiones Mediæ*, or other works.

| Star's Name. | R.A. | | | N.P.D. | | | |
|---|---|---|---|---|---|---|---|
| | h | m | s | ° | ′ | ″ | |
| *h* 2021 | 1 | 0 | 37 | 109 | 31 | 40 | Is it really close double?—"Violent suspicion." |
| Σ 168 | 1 | 40 | 17 | 20 | 47 | 30 | Not seen double by h. |
| Σ 211 | 1 | 55 | 54 | 96 | 14 | 50 | No such star found in, or near place by h. |
| Σ 343<br>347 | 2 | 55<br>56 | 23<br>27 | 6<br>6 | 35<br>35 | 32<br>2 | Are these the same double star? Σ is confused, and h disagrees. |
| Σ 407 | 3 | 21 | 56 | 101 | 43 | 4 | ? Is the minute of R.A. 19 or 21? Σ's two catalogues differ. |
| Σ′ 417<br>Σ 518 | 4 | 7<br>7 | 27<br>48 | 97 | 55<br>54 | 22<br>23 | 40 Eridani. Confusion exists. Wanted an exact diagram description, and measures of A, B, C; and ? of a 4th star, D. |
| Σ 609 | 4 | 41 | 59 | 89 | 8 | 59 | ? Whether Struve's place, as here given from "Positiones Mediæ," or that of my 7th Catalogue $4^h\ 43^m\ 4^s$, $89^\circ\ 3'\ 17''$ be right. Positions and distances agree. Or are they really two different double stars? *My place* is corroborated in 5th Catalogue, h 2240 *bis*, making the R.A. $43^m$. |
| Σ 662 | 5 | 5 | 39 | 94<br>64 | 15 | 54 | In Σ "Pos. Mediæ," the P.D. is $94^\circ\ 15'\ 54''$; but in the Dorpat Catalogue and also in the "Mensuræ Micrometricæ," the degree of P.D. is $64^\circ$. The declination given are Dorp. $+25^\circ\ 45'$; "Mens. Microm." $+25^\circ\ 45'$; "Pos. Med." $-4^\circ\ 15'\ 54''$. |
| h 5465 | 5 | 39 | 18 | 78 | 4 | 3 | An excessively minute *comes* 12″ distant suspected. ? if verified. |
| Σ 923 | 6 | 22<br>42 | 15<br>15 | 30 | 25 | 8 | ? Which is the right minute of R.A.? Σ leaves it doubtful, and I have no observation of it. |
| Σ 1006 | 6 | 51 | 22 | 26<br>27 | 59<br>10 | 18<br>18 | Which is the right P.D.? In the Dorpat Catalogue the declination is $+63^\circ\ 1'$; in the "Mens. Microm." $+62^\circ\ 50'$. Which is right? |
| Σ′(989) *g.c.*<br>σ 295 | 8<br>8 | 14<br>14 | 22<br>25 | 92<br>92 | 25<br>23 | 7<br>51 | Set down as "very near" σ 295 (Catalogi Prioris.) Are these really two different double stars? If not, which is right? |
| Σ 1259 | 8 | 32 | 7 | 51 | 5 | 29 | In Dorpat Catalogue $8^h\ 31^m{\cdot}9$, Decl. $+38^\circ\ 56'$. In "Mens. Microm." $8^h\ 36^m$, Decl. $+39^\circ\ 5'$. Query which is right. h has no observation. |
| δ Cancri | 8 | 35 | 1 | 71 | 13 | 39 | h 457 makes Position 160°, Distance 25″; Lassell, "Astr. Nach." No. 858, states it as Position 121·°12, Distance 45″. What is it really? |

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| Star's Name. | R.A. | | | N.P.D. | | | |
|---|---|---|---|---|---|---|---|
| | h | m | s | ° | ′ | ″ | |
| Cancri | 12 | 29 | – | 75 | 17 | | Close to a star of 9th Mag. is a small, well-defined body, *which may be* a close double star. *np* is a very faint nebula (no doubt III. 602, or Neb. No. 3113 of my general Catalogue.) ? Is it there still? Was it a planet? |
| κ Virginis | 14 | 3 | 50 | 99 | 28 | 42 | σ 453 (Catalogi Prioris.) Is it really a double star? |
| ω Boötis | 14 | 54 | 40 | 64 | 18 | 58 | σ 469. Is it really double? |
| h 1271 | 15 | 15 | 18 | 107 | 59 | 48 | Are these identical; and if so, which P.D. (differing 1°) is the right? The measures agree. |
| h 4768 | 15 | 15 | 18 | 109 | 0 | 43 | |
| h 256 | 15 | 32 | 2 | 71 | 40 | 0 | Not found subsequently; but ? if properly looked for. Does it exist? Measures 5° *sf.*; distance 2″. |
| Σ 2012 | 16 | 0 | 49 | 97 | 48 | 13 | Is this really identical with B.A.C. 5379? |
| h 584 | 16 | 7<br>13 | 58 | 50 | 20 | 45 | R.A. between $7^{m}$ and $13^{m}$. ? The right minute. |
| Σ′ (1814) | 16 | 16 | 48 | 88 | 23 | 2 | "Loco 2041" Are these really two double stars? And if so, to which does the description, Position 4°·40, Distance $3^{s}$·060, belong? |
| Σ 2041 | 16 | 16 | 48 | 88 | 21 | 35 | |
| Mayer | 17 | 1 | 29 | 114 | 2 | 43 | Is there any double star in this place? |
| Σ 2190 | 17 | 29 ± | | 68 | 53 | | The measures of this star are very conflicting. Σ (1829) makes Position 33°·22. h (1830), by a sweep, 18°·4 (plainly written in original, and diagram agreeing.) Mädler (1843), 33°·67; and Dembrowski (1863), 23°·00. Which is right? |
| H 4599 | 18 | 57 | 0 | 58 | 32 | 41 | Query as to its existence in this place, or very near it. |
| Σ 2545 | 19<br>19 | 27<br>29 | 32<br>23 | 100 | 31 | 57 | Smyth described this as "closely following" a star R.A. $19^{h}\,27^{m}\,28^{s}$, and the R.A. $19^{h}\,27^{m}\,32^{s}$ given by him differs $2^{m}$ from Σ. Which is right? |
| Σ′ (2360) | 19 | 40 | 4 | 57 | 31 | 25 | Are these not identical; the P.D. applied to H h 640 being 11′ wrong? |
| H 4640 | 19 | 39 | 54 | 57 | 19 | 48 | |
| Σ 2634 | 20 | 1 | 50 | 73 | 41 | 46 | Smyth identifies his No. 733 (Cycle) with this star, and with H h 668; but his P.D. 73°33′54″ (for 1830) differs 8′. Are these two double stars? |
| σ 680 | 20 | 22 | 53 | 79 | 23 | 3 | Are these the same double star? Σ 2690 is identified with Dawes (1); h (269); H h 691; and O.Σ 407. |
| Σ 2690 | 20 | 23 | 6 | 79 | 18 | 22 | |
| h 2994 | 20 | 36 | 18 | 112 | 7 | 33 | 17 Capricorni. Requires verification as a Position 338·°7, Distance 20″. A *very* minute companion. |
| h 1619<br>h 1620 | 21 | 4 | 22 | 76<br>77 | 9<br>9 | 37<br>35 | Are not these the same; but 1° P.D. mistaken in one or other? Which is right? 1620 is described as *quadruple*. |
| h 5517 | 21 | 14 | 54 | 103 | 36 | 6 | 18 *Aquarii.* Query a very minute companion preceding, at 13″ distance. |
| Σ 2792 | 21 | 15 | 42 | 61 | 46 | 6 | Query if not the same, with 1° error in P.D. in one or other; and, if so, which is right? |
| *h* 1638 | 21 | 15 | 43 | 62 | 46 | 43 | |
| h 935 | 21 | 19 | 20 | 56<br>57 | 28 | 26 | Two observations differ by 1° P.D. Query which is right? |
| Σ 2827 | 21 | 38 | 54 | 28 | 9 | 54 | "Loco Σ 2827." The latter star seems to be only the former, with its place better determined. Σ 2827 is a really existing double star =h 1690=Σ 2827 of the "Mens. Microm." Are those really two double stars very near each other? h 1690's place is $21^{h}\,39^{m}\,32^{s}$, N.P.D. 27° 11′ 1″. |
| Σ′ (2628) | 21 | 39 | 5 | | 8 | 39 | |

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| Star's Name. | R.A. h | m | s | N.P.D. ° | ′ | ″ | |
|---|---|---|---|---|---|---|---|
| h 1761 | 22 | 16 | 24 | 16 | 0 | 38 | Oblong. Requires re-examination. |
| h 5529 | 22 | 28 | 57 | 95 | 6 | 4 | *κ Aquarii.* An excessively minute companion strongly suspected. |
| h 3158 | 22 | 53 | 15 | 20 | 8 | 37 | Excessively close. Requires verification. Position 45°. |
| Sh 358 | 23 | 46 | 20 | 59 | 6 | 20 | ? If two distinct double stars. If only one, ? its place. |
| σ 690 | | 49 | 22 | | 11 | 40 | |

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## *Note on a Pair of Differential Equations in the Lunar Theory.*

By Prof. Cayley.

The equations

$$\frac{d}{dt}\,\frac{d\varrho}{dt} - \varrho\left(\frac{dv}{dt}\right)^2 + \frac{1}{\varrho^2} = k\,m^2\varrho\,\left\{\frac{1}{2} + \frac{3}{2}\cos\,(2\,v - 2\,m\,t)\right\},$$

$$\frac{d}{dt}\;\varrho^2\frac{dv}{dt} \qquad\qquad = j\,m^2\,\varrho^2\left\{\qquad \frac{3}{2}\sin\,(2\,v - 2\,m\,t)\right\},$$

taking therein $j = k = 1$ in effect present themselves in the Lunar Theory, and particular integrals in series have been obtained, the development being carried to a great extent; but I give the results only as far as $m^4$, viz., writing

$$t - m\,t = \mathrm{D},$$

we have

$$\begin{aligned} v = t &+ \left(\frac{11}{8}\,m^2 + \frac{59}{12}\,m^3 + \frac{893}{72}\,m^4\right)\sin 2\,\mathrm{D} \\ &+ \frac{201}{256}\,m^4 \quad \sin 4\,\mathrm{D}, \end{aligned}$$

$$\begin{aligned} 1 = 1 &+ \quad \frac{1}{6}\,m^2 \qquad\qquad \frac{179}{288}\,m^4 \\ &+ \left(\quad m \;+ \frac{19}{6}\,m^3 + \frac{131}{18}\,m^4\right)\cos 2\,\mathrm{D} \\ &+ \frac{7}{8}\;m^4 \quad \cos 4\,\mathrm{D}, \end{aligned}$$

In the Lunar Theory $j$ and $k$ are properly each $= \dfrac{1}{1+\dfrac{\mathrm{E}}{m'}}$ (E the mass of the Earth, $m'$ that of the Sun), but they are taken to be $= 1$; the numerical difference is inappreciable; but there would be a considerable theoretical advantage in retaining in the equations the coefficients $j$, $k$: in fact, the developments could then be arranged according to the powers of $k$, that is according to the powers of the disturbing force; whereas, when $k$ is taken $= 1$, we have only a development in powers of $m$, and since $m$ also presents itself through the coefficient $2 - 2\,m$ of $t$ in $2\,v - 2\,m\,t$, terms which are really of different orders in regard to the disturbing force, are united together into a single term: in fact, instead of a term of the form $(\mathrm{A}k + \mathrm{B}\,k^2 + \text{\&c.})\;m^p$, where A, B, are numerical,